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(54) TUBING CONNECTOR

VERBINDER FÜR EINEN ROHRSTRANG
RACCORD DE TUYAUTERIE

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D scription

[0001] This invention relates to a tubing connector, and in particular to a connector for use in joining lengths of expandable tubing.

[0002] WO-A-93\25800 (Shell Internationale Research), the disclosure of which is incorporated herein by reference, describes a method of completing an uncased section of a borehole in an underground oil-bearing formation. An expandable liner provided with overlapping longitudinal slots is fixed at a predetermined position in the borehole. A tapered expansion mandrel is then moved through the liner and expands the liner to a diameter larger than the mandrel maximum diameter. In particular, the tubing expands by deformation of the liner wall and enlargement of the slots: the wall pieces of the slotted liner where the slots do not overlap, that is the areas between the ends of axially aligned slots, deform in circumferential direction; and in the adjacent sections wherein the slots do overlap the wall pieces between adjacent slots rotate and bend out of the cylindrical surface of the undeformed liner. Ideally, the liner is expanded to such an extent that it contacts the bore wall.

[0003] In certain applications it is desirable to provide a relatively long section of borehole with slotted liner. This requires two or more lengths of slotted liner to be joined together at the surface, prior to running into the borehole. Conventionally, the lengths of liner are welded together, however this is a time-consuming and potentially dangerous operation, due to the elevated temperatures created by the welding process. The heat created by the welding operation may also affect the properties of the metal at the liner ends. Achieving consistent weld quality may also be difficult, particularly when the welding operation is to be carried out, for example, in exposed conditions on an offshore facility. Further, if any problems are encountered while running the liner into the borehole, and the liner string must be retrieved, it is not possible to disconnect the welded lengths of tubing and these must be cut apart, and the cut lengths may have to be scrapped.

[0004] It is among the objectives of the embodiments of the present invention to provide a tubing connector which will obviate or mitigate at least some of these disadvantages.

[0005] According to a first aspect of the present invention there is provided a tubing connector for joining the ends of two lengths of expandable tubing, the connector comprising two expandable tubular portions for mounting on the ends of the lengths of expandable tubing, each portion including a plurality of circumferentially spaced couplings for engaging corresponding couplings on the other portion, the engaging parts of the couplings being located on parts of the tubular portions which are substantially undeformed following expansion of the tubular portions.

[0006] For use with expandable tubing featuring overlapping longitudinal slots, the tubular portions may in-

clude corresponding overlapping longitudinal slots arranged such that the connected tubular portions exhibit a similar pattern of slots to the tubing, with the couplings located on the "nodes" between the ends of axially aligned slots.

[0007] To provide the connection with the necessary strength it will often be necessary for the thickness of material at the connected couplings, that is where the corresponding couplings overlap or meet, to be greater than that of the remainder of the tubular portions and the expandable tubing itself, such that the couplings may be upset from the inner or outer tubing surface.

[0008] Preferably, the couplings may be disconnected, to allow disconnection of the tubing lengths, if desired.

[0009] Preferably also, the cooperating or engaging parts of the coupling may define, for example, cooperating tongues and slots or pins and bores, the couplings may be threaded, and the couplings may define teeth or undercuts. The couplings will generally be provided in male and female form, that is one coupling is axially received within the other. The couplings may additionally be secured to one another by any suitable means or combination of means, including adhesive, radial screws or pins.

[0010] The couplings of one embodiment are in male and female form and define corresponding threads, the outer female coupling including a dog which is biased towards a position engaging the corresponding male coupling. Preferably, the dog is initially held in a retracted position and may be released, once the couplings are in the desired relative positions, to engage the male coupling. Conveniently, the dog is in the form of a sprung pin.

[0011] Preferably also, the longitudinal extent of each coupling is restricted to parts of the tubular portions which are substantially undeformed following expansion of the tubular portions.

[0012] The connector may be provided in combination with lengths of expandable tubing.

[0013] The tubular members may include radially extending handling shoulders, to facilitate handling of the respective tubing lengths.

[0014] The tubular members may be integral with the respective tubing lengths, or may be formed separately and welded or otherwise connected to the tubing length. In the former arrangement the ends of the tubing lengths are machined or otherwise shaped to form the tubular members. In the latter arrangement the tubular members may be at least partially formed and then welded or otherwise fixed to the tubing lengths; in a preferred embodiment the longitudinal slots in the tubing lengths and the tubular portions are formed once the tubular portions have been welded to the respective tubing lengths.

[0015] These and other aspects of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a side view of two lengths of expandable tubing which have been joined using a tubing connector in accordance with a preferred embodiment of the present invention;

Figure 2 is a sectional view of the tubing of Figure 1; Figures 3 through 9 are enlarged sectional views of parts of tubing connectors in accordance with various embodiments of the present invention;

Figures 10 and 11 are enlarged views of the connector of Figure 9 of the drawings; and

Figures 12 and 13 are sectional views of parts of a tubing connector in accordance with another aspect of the present invention.

[0016] Reference is first made to Figures 1 and 2 of the drawings, which illustrate two lengths of expandable longitudinally slotted tubing 10, 11 which have been joined together using a connector 12 in accordance with a preferred embodiment of the present invention. The tubing lengths 10, 11 are provided with overlapping longitudinal slots 14 (only some of the slots have been shown for drawing clarity), to allow the tubing to be expanded. The connector 12 comprises two expandable tubular portions 16, 17 which are slotted in a similar fashion to the lengths of tubing 10, 11. The tubular portions 16, 17 are welded to the ends of the respective tubing lengths 10, 11 and the slots then cut such that the tubular portions 16, 17 will expand in concert with the tubing lengths 10, 11. Further tubular portions 16a, 17a are also shown mounted to the free ends of the tubing lengths 10, 11.

[0017] Each tubing length 10, 11 carries a number of handling shoulders 18, and corresponding shoulders 19 are provided on the tubular portions 16, 17. The shoulders 18, 19 are useful when handling and transporting the various parts, and may also be used when connecting the tubular portions 16, 17, as will be described.

[0018] Each tubular portion 16, 17 includes a plurality of circumferentially spaced couplings 20, 21 at the portion free end, for engaging a corresponding coupling on the other tubular portion 17, 16; the couplings 20, 21 are located at "nodes" 22 between the ends of the slots 14 in the tubular portions 16, 17, the metal at the nodes 22 remaining substantially undeformed when the tubular portions 16, 17 are expanded.

[0019] Reference is now made to Figure 3 of the drawings, which illustrates a pair of couplings 20, 21 in greater detail. It will be noted that the coupling 20 defines a female portion 24 defining an internal screw thread and the coupling 21 defines a corresponding male portion 25 carrying an external thread and the ends of the portions 24, 25 are also undercut to minimise the possibility of radial separation. In addition, two screws 26, 27 fix the portions 24, 25 together.

[0020] It will be noted that the combined metal thickness of the joined couplings 20, 21 is greater than that of the adjacent tubular portions 16, 17, such that this form of connection would not be suitable where it was

desired to provide expandable tubing with a smooth or flush outer surface.

[0021] Reference is now made to Figure 4 of the drawings which illustrates threaded couplings 60, 61 which may be torqued up.

[0022] Figure 5 of the drawings illustrates couplings 64, 65 which define a "stab in" connector, that is the coupling 64, 65 are simply pushed together, and a single screw 66 is also provided for securing each pair of couplings 64, 65 together.

[0023] Figure 6 illustrates an arrangement in which one coupling 70 defines a threaded tongue 72 which is received by a slot 74 defined by a shroud 75 fixed on the other coupling 71. Further, a screw 76 is provided to secure the couplings 70, 71 together.

[0024] Figure 7 illustrates couplings 80, 81 defining ratchet threads 82, 83 with a back angle, and including a securing screw 84.

[0025] Figure 8 illustrates couplings 88, 89 without threads and held together by two screws 90, 91.

[0026] Reference is now made to Figure 9 of the drawings, illustrating couplings 130, 131 in accordance with another embodiment of the invention. In this example the couplings 130, 131 define hook or ratchet threads 132, 133 and undercut end surfaces 134, 135. Additionally, the coupling 130 includes a sprung latch pin 136, further details of which may be seen in Figures 10 and 11 of the drawings. The pin 136 is biased radially inwardly by a solid spring 140 acting between a ledge 142 defined on the pin 136 and a threaded retainer in the form of a grub screw 144 which is fixed in the outer end of the bore 146 which accommodates the pin 136. The pin 136 is thus biased radially inwardly, but is initially retained in a retracted position (Figure 10) by a spring clip 148 which engages an annular groove 150 in the outer end of the pin 136. The clip 148 is removed once the couplings 130, 131 have been made up, the head of the pin 136 then extending into a corresponding recess 152 in the end of the coupling 131, to prevent relative rotation of the couplings 130, 131.

[0027] Figures 12 and 13 illustrate couplings 160, 161 in which the couplings define threads 162, 163 and have tongued ends 164, 165 to engage corresponding grooves in the other coupling to prevent separation of the couplings 160, 161 on expansion of the connector. Like the embodiment illustrated in Figures 9, 10 and 11, the coupling 160 includes a spring latch pin or pin-lock 166, however, in this embodiment the pin 168 has a removable threaded head 170 and utilises a coil spring 172.

[0028] All of the embodiments described above are intended to be robust and to allow lengths of expandable tubing to be made up quickly and securely on site. The particular form of connection utilised will depend upon the particular application.

Claims

1. A tubing connector (12) for joining the ends of two lengths of expandable tubing (10, 11); the connector (12) comprising two expandable tubular portions (16, 17) for mounting on the ends of the lengths of expandable tubing (10, 11), each portion (16, 17) including a plurality of circumferentially spaced couplings (20, 21) for engaging corresponding couplings on the other portion, the engaging parts of the couplings (24, 25) being located on parts of the tubular portions which are substantially undeformed following expansion of the tubular portions. 5
2. The connector of claim 1, wherein the tubular portions include overlapping longitudinal slots defining nodes (22) between the ends of axially aligned slots, the couplings (20, 21) being located on the nodes. 10
3. The connector of claim 1 or 2, wherein the thickness of material at the connected couplings (20, 21) is greater than that of the remainder of the tubular portions (16, 17), such that the couplings are upset from the tubing surface. 15
4. The connector of claim 1, 2 or 3, wherein engaged couplings (20, 21) are disconnectable, to allow disconnection of joined tubing lengths. 20
5. The connector of any of claims 1 to 4, wherein the engaging parts of the coupling define cooperating tongues (72) and slots (74). 25
6. The connector of any of claims 1 to 4, wherein the engaging parts of the coupling define cooperating pins (136) and bores (146). 30
7. The connector of any of the preceding claims, wherein the couplings (20, 21) are threaded. 35
8. The connector of any of the preceding claims, wherein the couplings define teeth. 40
9. The connector of any of the preceding claims wherein the couplings define undercuts. 45
10. The connector of any of the preceding claims wherein the couplings (20, 21) are in male and female form. 50
11. The connector of any of the preceding claims wherein the couplings (20, 21) are securable to one another by adhesive. 55
12. The connector of any of the preceding claims wherein the couplings (20, 21) are securable to one another by radially extending fasteners.

13. The connector of any of the preceding claims, wherein the couplings are in male (25) and female (24) form and define corresponding threads, the outer female coupling including a dog which is biased towards a position engaging the corresponding male coupling.
14. The connector of claim 13, wherein the dog is initially held in a retracted position and is releasable, once the couplings are in the desired relative positions, to engage the male coupling.
15. The connector of claim 13 or 14, wherein the dog is in the form of a sprung pin (136).
16. The connector of any of the preceding claims, wherein the tubular portions include radially extending handling shoulders.
17. The connector of any of the preceding claims, in combination with lengths of expandable tubing.

Patentansprüche

1. Rohrverbinder (12) zur Verbindung der Enden von zwei Längen eines aufweitbaren Rohrstrangs (10, 11), wobei der Verbinder (12) zwei aufweitbare Rohrstrangabschnitte (16, 17) zur Anbringung an den Enden der Längen des aufweitbaren Rohrstrangs (10, 11) umfaßt, wobei jeder Abschnitt (16, 17) eine Vielzahl von mit Zwischenraum über dem Umfang angeordneten Kupplungen (20, 21) für das ineinandergreifen mit entsprechenden Kupplungen auf dem anderen Abschnitt einschließt, wobei sich die Eingriffsteile der Kupplungen (24, 25) auf Teilen der Rohrstrangabschnitte befinden, die nach dem Aufweiten der Rohrstrangabschnitte im wesentlichen unverformt sind.
2. Rohrverbinder nach Anspruch 1, bei dem die Rohrstrangabschnitte sich überdeckende Längsschlitzte einschließen, die zwischen den Enden von in Axialrichtung ausgerichteten Schlitzten Knotenpunkte bilden, wobei sich die Kupplungen (20, 21) an den Knotenpunkten befinden.
3. Rohrverbinder nach Anspruch 1 oder 2, bei dem die Dicke des Materials an den verbundenen Kupplungen (20, 21) größer als die des Restes der Rohrstrangabschnitte (16, 17) ist, so daß die Kupplungen gegenüber der Rohrstrangoberfläche vorstehen.
4. Rohrverbinder nach Anspruch 1, 2 oder 3, bei dem die im Eingriff befindlichen Kupplungen (20, 21) getrennt werden können, um die Trennung der verbundenen Rohrstranglängen zu erlauben.

5. Rohrverbinder nach einem der Ansprüche 1 bis 4, bei dem die Eingriffsteile der Kupplung zusammenwirkende Zungen (72) und Schlitze (74) definieren.
6. Rohrverbinder nach einem der Ansprüche 1 bis 4, bei dem die Eingriffsteile der Kupplung zusammenwirkende Bolzen (136) und Bohrungen (146) definieren.
7. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen (20, 21) mit Gewinde versehen sind.
8. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen Zähne definieren.
9. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen Unterschneidungen definieren.
10. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen (20, 21) in Form von Innen- und Außenkomponenten ausgeführt sind.
11. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen (20, 21) durch einen Klebstoff aneinander befestigt werden können.
12. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen (20, 21) durch in Radialrichtung verlaufende Befestigungselemente aneinander befestigt werden können.
13. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Kupplungen in Form von Innen- (25) und Außenkomponenten (24) ausgeführt sind und entsprechende Gewinde definieren, wobei die äußere Innengewindekupplung einen Anschlag einschließt, der zu einer Position hin vorgespannt ist, an welcher der Eingriff mit der entsprechenden Außengewindekupplung erfolgt.
14. Rohrverbinder nach Anspruch 13, bei dem der Anschlag zuerst in einer zurückgezogenen Position gehalten wird und ausgelöst werden kann, sobald sich die Kupplungen in den gewünschten relativen Positionen befinden, um in die Außengewindekupplung einzugreifen.
15. Rohrverbinder nach Anspruch 13 oder 14, bei dem der Anschlag die Form eines federgespannten Bolzens (136) hat.
16. Rohrverbinder nach einem der vorhergehenden Ansprüche, bei dem die Rohrstrangabschnitte in

Radialrichtung verlaufende Transportabsätze einschließen.

17. Rohrverbinder nach einem der vorhergehenden Ansprüche in Kombination mit Längen von aufweitbaren Rohrsträngen.

Revendications

1. Raccord de tuyauterie (12) destiné à relier les extrémités de deux longueurs de tuyau dilatable (10, 11); le raccord (12) comprenant deux parties tubulaires dilatables (16, 17) destinées à être montées sur les extrémités des longueurs de tuyau dilatable (10, 11), chaque partie (16, 17) englobant plusieurs dispositifs de raccordement espacés circonférentiellement (20, 21) destinés à s'engager dans des dispositifs de raccordement correspondants sur l'autre partie, les parties d'engagement des dispositifs de raccordement (24, 25) étant agencées sur des parties des parties tubulaires pratiquement non déformées après la dilatation des parties tubulaires.
2. Raccord selon la revendication 1, dans lequel les parties tubulaires englobent des fentes longitudinales à chevauchement, définissant des noeuds (22) entre les extrémités de fentes à alignement axial, les dispositifs de raccordement (20, 21) étant agencés sur les noeuds.
3. Raccord selon les revendications 1 ou 2, dans lequel l'épaisseur du matériau au niveau de dispositifs de raccordement connectés (20, 21) est supérieure à celle de la partie restante des parties tubulaires (16, 17), de sorte que les dispositifs de raccordement débordent de la surface du tuyau.
4. Raccord selon les revendications 1, 2 ou 3, dans lequel les dispositifs de raccordement engagés (20, 21) peuvent être déconnectés pour permettre la déconnexion de longueurs de tuyau reliées.
5. Raccord selon l'une quelconque des revendications 1 à 4, dans lequel les parties engagées du dispositif de raccordement définissent des languettes (72) et des fentes (74) de coopération.
6. Raccord selon l'une quelconque des revendications 1 à 4, dans lequel les parties engagées du dispositif de raccordement définissent des goupilles (136) et des alésages (146) de coopération.
7. Raccord selon l'une quelconque des revendications précédentes, dans lequel les dispositifs de raccordement (20, 21) sont filetés.
8. Raccord selon l'une quelconque des revendications

précédentes, dans lequel les dispositifs de raccordement définissent des dents.

9. Raccord selon l'une quelconque des revendications précédentes, dans lequel les dispositifs de raccordement définissent des entailles. 5
10. Raccord selon l'une quelconque des revendications précédentes, dans lequel les dispositifs de raccordement (20, 21) se présentent sous une forme mâle et une forme femelle. 10
11. Raccord selon l'une quelconque des revendications précédentes, dans lequel les dispositifs de raccordement (20, 21) peuvent être fixés l'un à l'autre par l'intermédiaire d'un adhésif. 15
12. Raccord selon l'une quelconque des revendications précédentes, dans lequel les dispositifs de raccordement (20, 21) peuvent être fixés l'un à l'autre par l'intermédiaire d'éléments de fixation à extension radiale. 20
13. Raccord selon l'une quelconque des revendications précédentes, dans lequel les dispositifs de raccordement se présentent sous une forme mâle (25) et une forme femelle (24) et définissent des filetages correspondants, le dispositif de raccordement femelle externe englobant une came poussée vers une position d'engagement dans le dispositif de raccordement mâle correspondant. 25
30
14. Raccord selon la revendication 13, dans lequel la came est initialement retenue dans une position rétractée et peut être relâchée après l'agencement des dispositifs de raccordement dans les positions relatives voulues, en vue d'un engagement dans le dispositif de raccordement mâle. 35
15. Raccord selon les revendications 13 ou 14, dans lequel la came a la forme d'une goupille à ressort (136). 40
16. Raccord selon l'une quelconque des revendications précédentes, dans lequel les parties tubulaires englobent des épaulements de manipulation à extension radiale. 45
17. Raccord selon l'une quelconque des revendications précédentes, en combinaison avec des longueurs de tuyau dilatable. 50

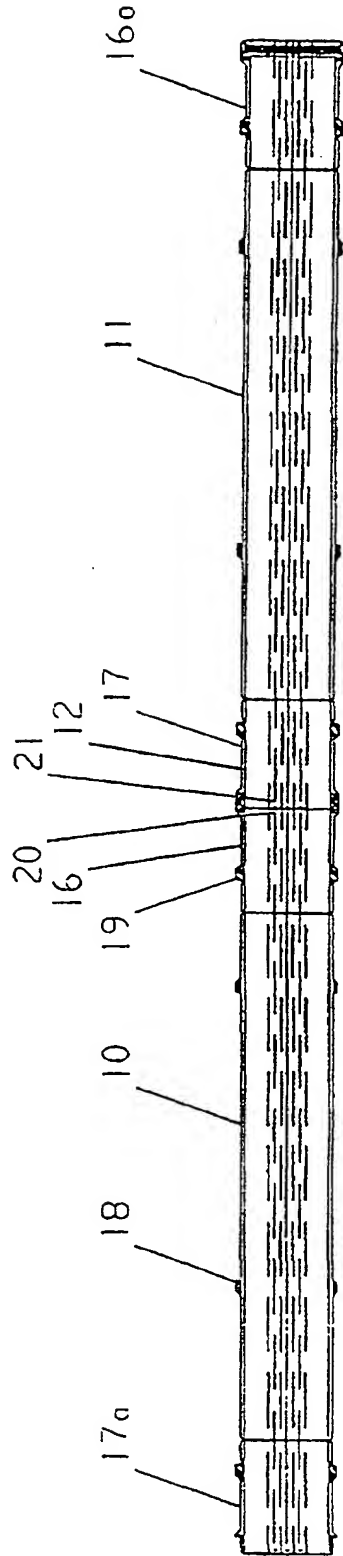


FIGURE 2

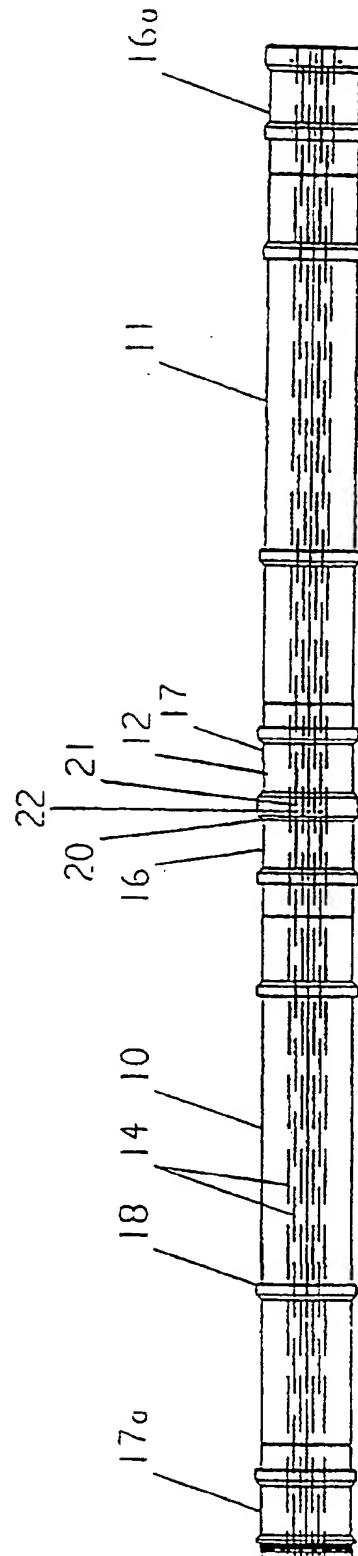


FIGURE 1

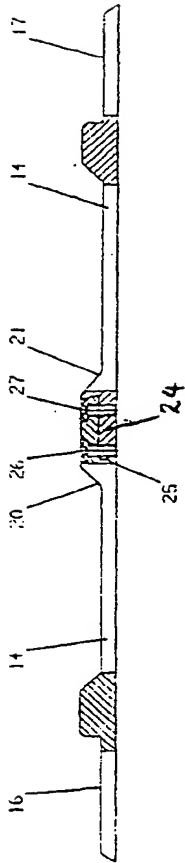


FIGURE 3

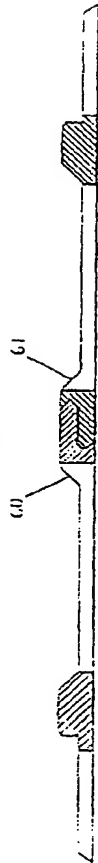


FIGURE 4

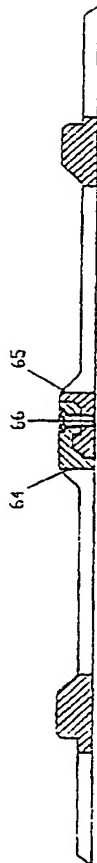


FIGURE 5

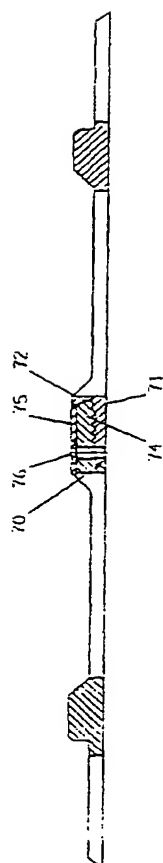


FIGURE 6

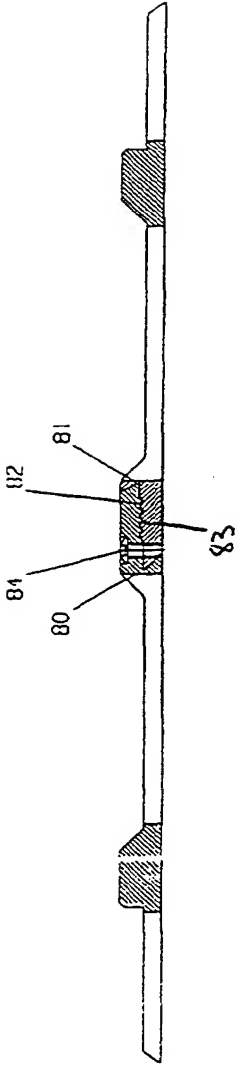


FIGURE 7

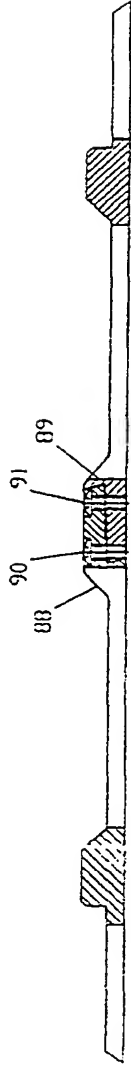


FIGURE 8

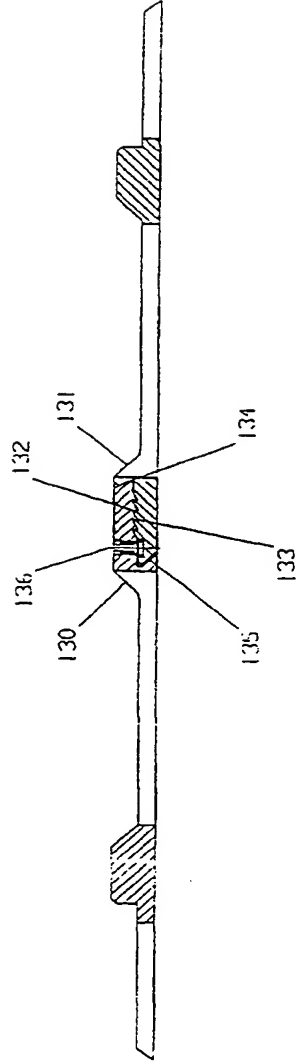
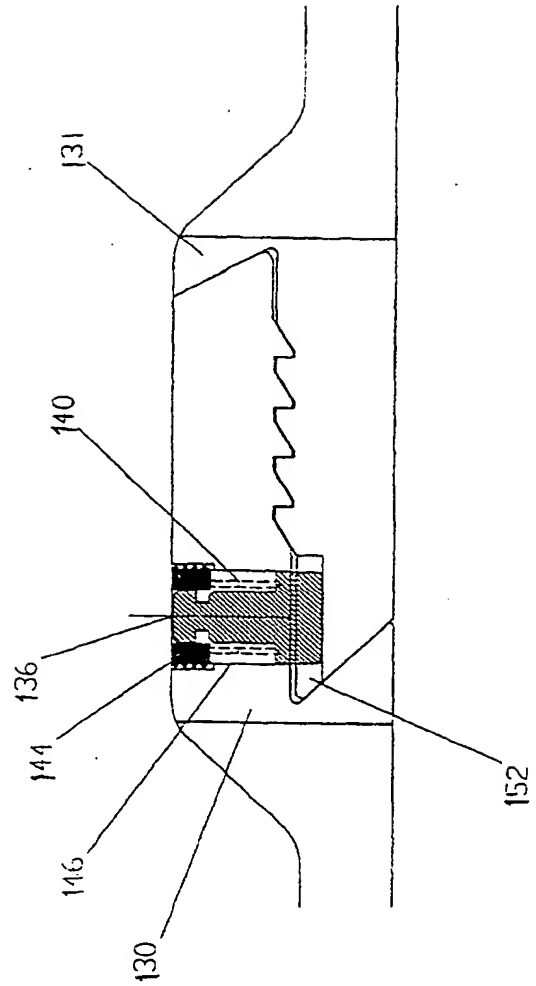
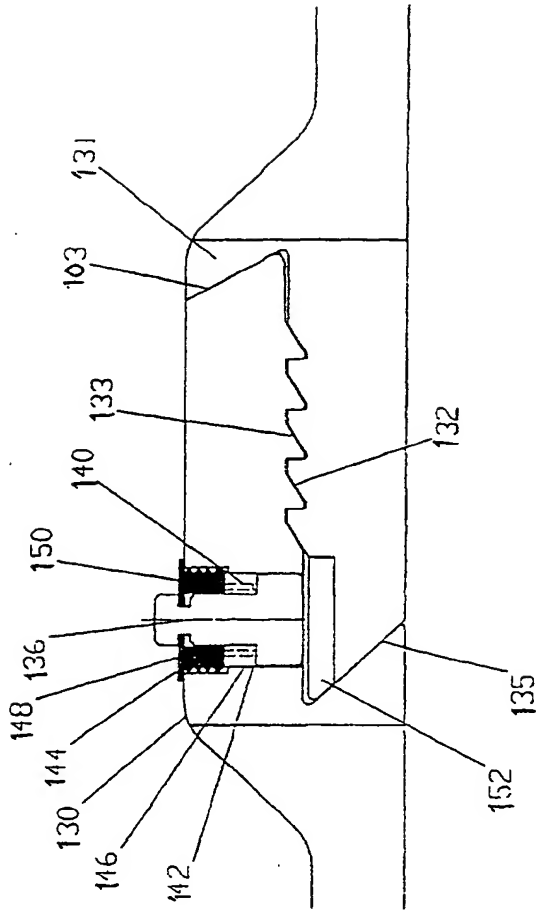


FIGURE 9



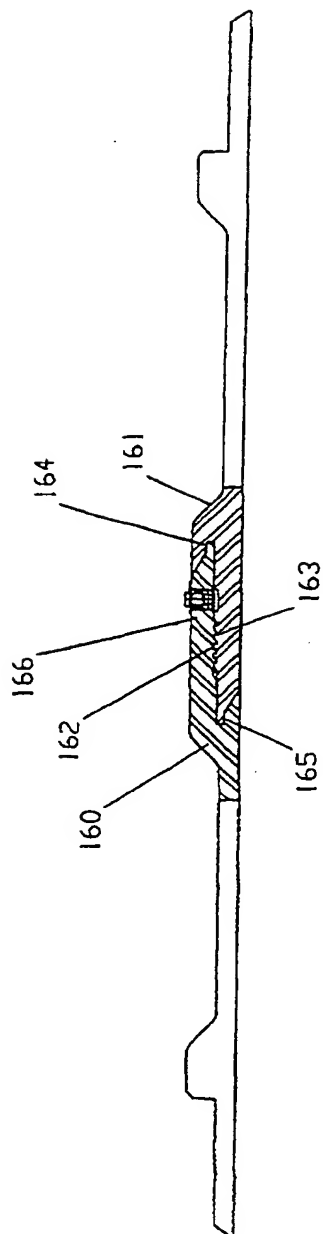


FIGURE 12

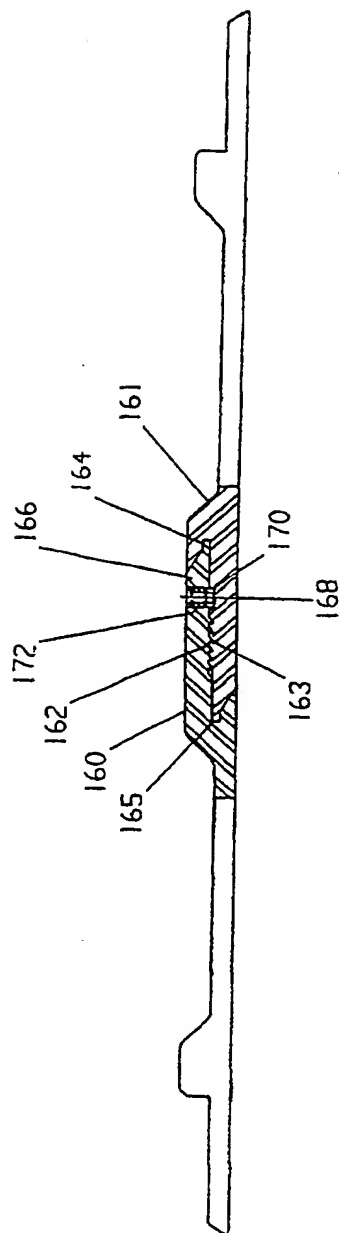


FIGURE 13